



Pomona Valley ITS Project

Project Deliverable 5.4.2 **Integration System User Requirements** **Project Deliverable 5.5.2** **Integration System Functional Requirements**

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PROJECT DESCRIPTION

The County of Los Angeles, in cooperation with the cities within the Pomona Valley, has determined that development of an Intelligent Transportation System (ITS) in the Pomona Valley would help to reduce congestion, enhance mobility, provide traveler information during non-recurring and event traffic congestion, and manage event traffic. The Pomona Valley Intelligent Transportation Systems (PVITS) project was conceived as a recommendation from the Pomona Valley ITS Feasibility Study completed by the LACMTA in 1995. The ultimate objectives of the Project are to:

- Improve mobility by optimizing traffic management on arterials and freeways;
- Enhance Route 60 capacity by better coordinating freeway traffic with parallel arterials;
- Improve agency efficiency by coordinating management of operations and maintenance efforts among and between agencies; and
- Increase agency staff productivity by providing low-maintenance, high-quality communications and computational tools to assist in daily management and coordination activities.

Phase 1 of the PVITS project is the development of a conceptual design that defines solutions to enhance capacity, reduce congestion, and improve traveler information in the Pomona Valley.



1.0 BACKGROUND

The Pomona Valley traffic management agencies' advanced traffic control systems (ATMS) will connect to each other primarily via the County's Information Exchange Network (IEN). The IEN allows operators at different agencies to monitor traffic on regionally significant arterials throughout LA County. The IEN network is designed for second-by-second communications in order to allow the sharing of traffic control system device data. Video, which requires higher bandwidths, will be shared on a separate network (or via the Internet where appropriate).

This document describes the user and functional requirements necessary to provide the connection between an existing or planned ATMS at a city and the IEN wide area network and video network to share information among agencies within and outside of the Pomona Valley Forum. The primary "connection" to the IEN is accomplished by a command/ data interface (CDI), which translates the ATMS data into the common IEN "language".

1.1 Purpose of Report

This report describes the user and functional requirements for the integration component of the Pomona Valley ITS. The integration component is those parts of the system(s) that allow the different agencies in the subregion to communicate and coordinate with one another. The integration component will include the CDI defined by the San Gabriel Valley Pilot Project, that allows an ATMS to connect to a wide area network for data sharing (including potential sharing of control as desired and agreed upon by each individual agency). The integration component may include other connections required to allow the various stakeholders and system components (e.g., ATMS, ATIS) to connect to form a seamless traffic management and traveler information system for the Pomona Valley.

1.2 Methodology

Based on interviews with stakeholders, input at project meetings, and feedback on other deliverables and analyses (including the **Deliverable 6.1.2 – Concept of Operations/ Area Architecture**), the user requirements were first developed for the integration needs of the subregion. The functional requirements of the integration component were then developed based on those user requirements and the requirements of the IEN defined in the San Gabriel Valley Project by Transcore. A numbering scheme has been employed (throughout this project) to enable mapping of requirements through the detail design, implementation and testing of the system.

1.3 Report Organization

The information in this report is presented in the following sections:

Section 1 – Background

Section 2 – Planned Area Architecture Summary

Section 3 – User Requirements

Section 4 – Functional Requirements

Section 5 – List of Acronyms



2.0 PLANNED AREA ARCHITECTURE SUMMARY

The area architecture shown in **Figure 2-1** depicts the different agencies, stakeholders, systems, subsystems and communication networks that comprise the Pomona Valley ITS program. In order for these components to communicate with one another, share monitoring ability and share potential control of field elements, there are integration issues that need to be addressed and designed for.

A key component of the architecture for the Pomona Valley is the IEN. The IEN will act as the primary communication network for exchange of information and sharing of monitoring and potential sharing of control. As such, the functional requirements include requirements (as shown or slightly revised based on project terminology) in the IEN requirements documentation.

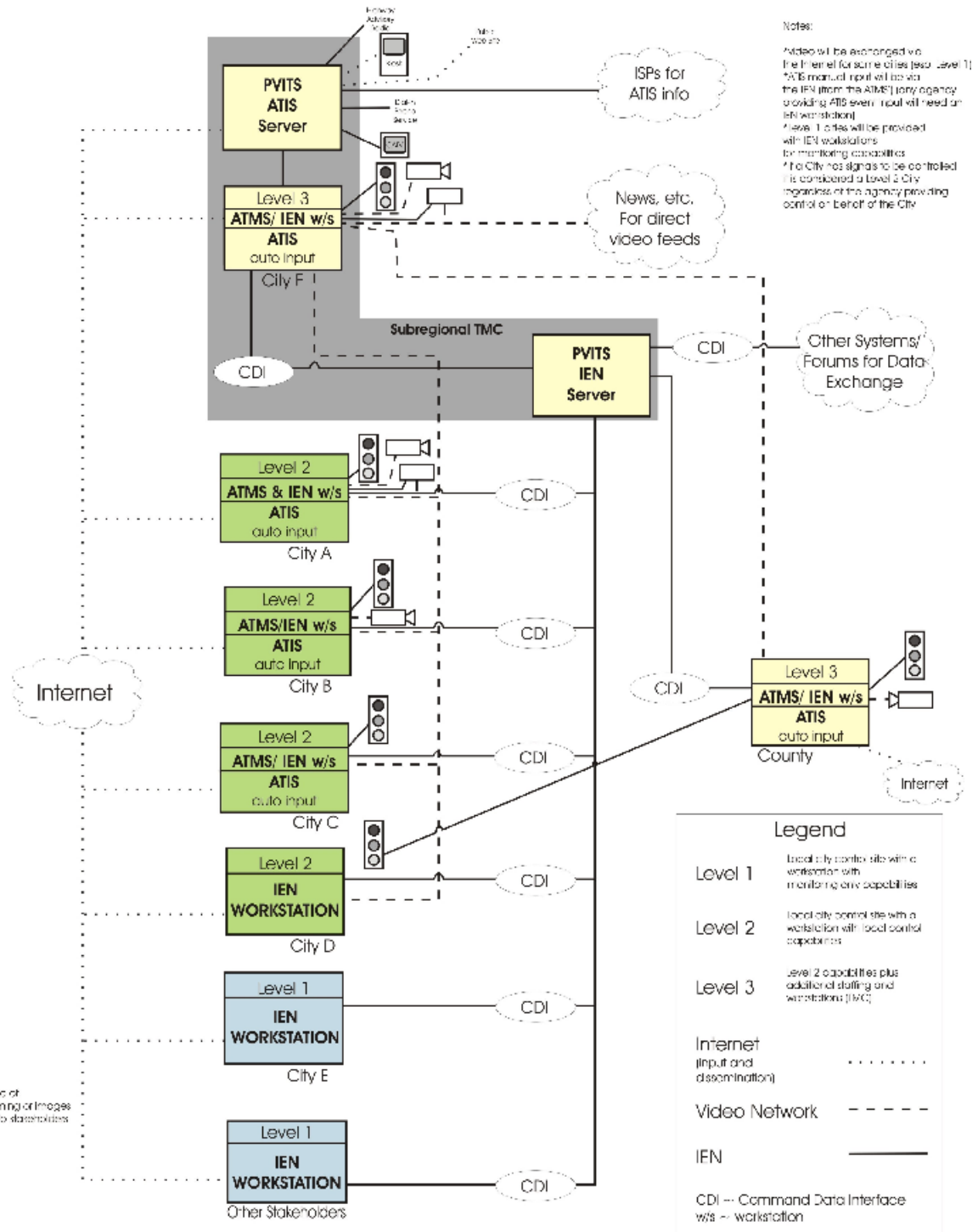


Figure 2-1 Planned Pomona Valley Area Architecture



3.0 USER REQUIREMENTS

This section describes the user requirements based on the architecture summary shown in **Section 2.0** and previous project deliverables and stakeholder input.

3.1 Operational Requirements

3.1.1 Data collection

- Each agency should operate and maintain its own field devices to provide for data collection (detector and controller data) from the field.

3.1.2 Future ITS Elements

- Each agency should have the ability to add future ITS devices.
- Future ITS elements for each agency will be designed to accommodate the existing/ planned ATMS for that agency and to accommodate any subregional integration requirements.

3.1.3 Information Exchange

- Each agency should have the ability to exchange data (monitoring) with other agencies and stakeholders in the subregion.
- Each agency should have the ability to exchange data (monitoring) with other agencies and stakeholders in the County-wide network.

3.1.4 Level of control

- Each agency will have the ability to ultimately control which agency or user has control of any elements/ field devices, subsystem or system owned by that agency.
- Different levels of control will be definable such that different users/ agencies can be assigned different levels of control for different elements/ field devices, subsystem or system.

3.1.5 Modes of Operation

- The integration component of the subregional ITS will support different modes of operation for traffic signal control, based on what each ATMS can perform.

3.2 Security

- There will be appropriate security measures in place for the integration component of the subregional ITS equal to or greater than those required at each agency's/ stakeholder's level.

3.3 Interjurisdictional Requirements

- Each agency would like the ability to coordinate traffic signals across jurisdictional boundaries.
- Agencies would like the ability to potentially share control of field elements such as CCTV cameras or implementing pre-defined and pre-agreed upon timing plans on behalf of another agency.



3.4 Maintenance Requirements

- The integration component for the subregional ITS will be operated and maintained by a subregional agreement that enters all partner agencies/ stakeholders into a combined and jointly funded operations and maintenance arrangement.
- The integration component for the subregional ITS should minimize additional maintenance.

3.5 Staffing and Training Requirements

- The integration component is not anticipated to require any additional staffing or minimum training of agency staff.

3.6 Cost Requirements

- All components of the system should be designed where possible to minimize operations and maintenance costs.

3.7 Public Relations/ Political Considerations

- No public relations or political considerations have been identified at this time.

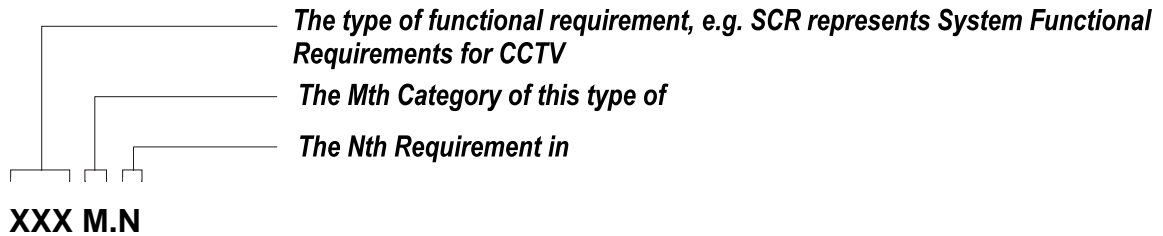
4.0 FUNCTIONAL REQUIREMENTS

This section presents the functional requirements for the PVITS integration component that are necessary in order to satisfy the user requirements described previously. The integration functional requirements describe the requirements of each agency ATMS, CDI, and or other systems or subsystems required to create a cohesive, integrated interjurisdictional system for managing traffic in the Pomona Valley region.

Los Angeles County, one of the major PVITS stakeholders, has been a leader in the development of the integration of systems within each Forum in LA County and has previously identified functional requirements for the IEN through the San Gabriel Valley Pilot Project. Those requirements that were defined for the IEN that are critical to the integration of systems in the Pomona Valley Forum have been extracted from that report and included here as the basis of the integration component for the Pomona Valley. Those requirements that have been extracted from the IEN design have been identified as such for tracking purposes. Minor changes have been made to some of the IEN requirements, based primarily on terminology differences between the two projects. Those cases where the IEN requirement has been changed have been noted as such.



4.1 Requirements Tracking



For example, SCR 2.3 represents the 3rd requirement in category 2 of the System Functional Requirements for CCTV

All functional requirements are uniquely numbered so that they can be tracked during all phases of the project. Requirements tracking is necessary because it is anticipated that the functional requirements for the Pomona integration system will continue to evolve during the course of the project. Changes in functional requirements can occur when users desire additional system capabilities based on new information that had not come to light during an earlier stage of the project, or perhaps the recognition that satisfying a particular requirement is not technically feasible. The following numbering convention is adopted in this document with regards to the requirement numbers.

The requirements tracking process will be utilized through the design, implementation, and testing phases of the project. By establishing and maintaining a relationship between the requirements, design, implementation, and test plans for the system, the impact of any changes to the requirements can be immediately identified and assessed.

4.2 System Performance (SIR.1)

Functional Req. #	Name	Requirement Statement	IEN Req #	IEN Req Changed
SIR.1.01	Dynamic Data Availability	All data required for local, subregional and county-wide display and monitoring will be maintained to permit high-speed access. Dynamic data will be available to Local Control centers and the County Server.	2.1.2.2.2.a	Y



4.3 Interface Requirements between System Components (SIR.2)

Functional Req #	Name	Requirement Statement	IEN Req #	IEN Req Changed
SIR.2.01	Security	Workstations on the IEN network will not be connected to office or other networks.	2.1.2.1.3.c	Y
SIR.2.02	Internet	Each agency should have internet access.		
SIR.2.03	CCTV video exchange	Each agency desiring video exchange shall have either internet access or access to the CCTV video network for the Pomona Valley. Video can not currently be exchanged via the IEN.		
SIR.2.04	ATIS automatic data collection	ATIS data will be collected automatically from each agency's ATMS.		
SIR.2.05	ATIS manual data collection	ATIS manually-input data can be collected via the IEN workstations at each agency.		

4.4 Interface Protocol Standards (SIR.3)

Functional Req #	Name	Requirement Statement	IEN Req #	IEN Req Changed
SIR.3.01	External NTCIP or CORBA	The local ATMS will accept commands from and provide data to external systems via a CORBA interface or potentially an NTCIP port in the future.	2.1.2.3.10.a	Y
SIR.3.02	LACO Format	System will support LACO-IV and potentially NTCIP in the future.	2.1.2.5.6.g	Y
SIR.3.03	Command/Data Interface	CDIs will be used to interface existing and planned ATMS to the IEN.	2.1.5.a	Y
SIR.3.04	Functions Supported	Data and Control interfaces are subject to the capabilities of the existing/ planned ATMS.	2.1.5.1.a	Y
SIR.3.05	Local Data Access	CDI will translate existing ATMS data into IEN format, and will be available to all other agencies in the subregion.	2.1.5.1.1.a	Y
SIR.3.06	Corridor Data Access	CDI will translate existing ATMS data into IEN format, available to the subregional IEN server.	2.1.5.1.2.a	Y
SIR.3.07	System Command Implementation	CDI will translate "Scenario Response Plan" requests into ATMS-specific commands and plans.	2.1.5.1.3.a	Y
SIR.3.08	Corridor Event/ Alarm Generation	CDI will translate and interpret ATMS-specific events and alarms, and will generate standard events and alarms to the IEN and subregional IEN server.	2.1.5.1.5.a	Y



4.5 Interface Requirements between Systems within and outside the Forum Area (SIR.4)

Functional Req #	Name	Requirement Statement	IEN Req #	IEN Req Changed
SIR.4.01	Operational Monitoring	LACDPW will be able to monitor all signals in the region. (Fremont facility)	2.1.1.4.1.1.b	
SIR.4.02	Functional Monitoring	LACDPW will be able to perform functional monitoring of all signals that it maintains. (Alcazar facility)	2.1.1.4.1.1.c	
SIR.4.03	Operational Monitoring	MTA will be able to monitor all signals in the region.	2.1.1.4.1.3.a	
SIR.4.04	Adjacent Operations Monitoring	Local Agencies will be able to monitor operation of signals in adjacent jurisdictions.	2.1.1.4.1.3.c	
SIR.4.05	Functional Monitoring Delegation	Local Agencies will be able to redirect functional monitoring to alternate locations.	2.1.1.4.1.3.e	
SIR.4.06	CDI	The PV ITS project will develop a CDI for any existing and/ or planned ATMS.	2.1.1.4.2.2.b	Y
SIR.4.07	Monitor neighboring agency's plans and traffic conditions	Each agency's ATMS can reference plans and traffic conditions in neighboring agencies in order to select suitable plans.	2.1.1.1.b	Y
SIR.4.08	Coordination between groups	The system will allow time reference and plan selection to groups of signals that are synchronized (within same ATMS and across ATMS boundaries)	2.1.2.3.1.e	Y
SIR.4.09	Each local agency can confirm, reject, or amend System Response Plans.	In order to maintain local authority, each local agency will have the ability to confirm, reject, or amend actions within its jurisdiction caused by the implementation of a Scenario Response Plan from another agency.	2.1.2.3.9.b	
SIR.4.10	Inter-jurisdictional plan requests	The user interface will allow jurisdictions to request neighboring agencies to implement certain plans	2.1.2.5.8.a	
SIR.4.11	Scenario response to incident support	The user interface will allow designated lead agencies to implement scenario response plans in their area or across jurisdictional boundaries	2.1.2.5.8.b	
SIR.4.12	Inter-agency message exchange	The user interface will provide means for agencies to send electronic mail to other agencies	2.1.2.5.8.c	
SIR.4.13	Private video feed collection	Private parties (i.e. the media or TV stations) wishing to receive live video feeds from within the Pomona Valley will be able to connect to the ATIS server at the city that serves as the subregional TMC.		
SIR.4.14	Information Service Provider data collection	ISPs wishing to collect data from the ATIS for repackaging and distribution shall connect to the ATIS server at the subregional TMC.		
SIR.4.15	Other Forum data	Other forum agencies and/ or stakeholders		



Functional Req #	Name	Requirement Statement	IEN Req #	IEN Req Changed
	sharing	wishing to share data with the Pomona Valley System shall connect to the IEN server at the subregional TMC.		

4.6 Equipment and Technology (SIR.5)

Functional Req #	Name	Requirement Statement	IEN Req #	IEN Req Changed
SIR.5.01	Server Hardware	Local ATMS CDI servers, the Pomona Valley IEN server, and the LA County ATMS servers will be Intel based PCs running the latest version of Windows that is compatible with all County transportation software packages and currently maintained and supported by City and County maintenance staff	2.1.2.1.2.a	Y
SIR.5.02	Frame Relay	All sites within the system will be connected using a Frame Relay network or equivalent.	2.1.2.1.3.a	
SIR.5.03	Intranet	Private intranet using PVCs to connect FRADs at local sites to a Frame Relay Router (FRR) [or equivalent] at the County TOC.	2.1.2.1.3.b	
SIR.5.04	RDBMS	All static data will be maintained using an off-the-shelf Relational Database Management System (RDBMS) accessible via SQL.	2.1.2.2.1.a	
SIR.5.05	Scenario Response	The local ATMS will translate Scenario Response Plans from the subregional system into the correct set of local plan changes.	2.1.2.3.9.a	Y
SIR.5.06	Modes of Operation	The integration component of the subregional TMC will support different modes of operation for traffic signal control, based on what each ATMS can perform.		

4.7 Availability of Technology (SIR.6)

Functional Req #	Name	Requirement Statement	IEN Req #	IEN Req Changed
SIR.6.01	Technology Availability	The integration component hardware and software shall utilize the current industry standard technology at the time of development/ implementation.		

4.8 Adaptability, Flexibility, Expandability, Scalability and Extensibility (SIR.7)

Functional Req #	Name	Requirement Statement	IEN Req #	IEN Req Changed
SIR.7.01	Future Devices	The integration component shall allow agencies		



		the ability to add ITS devices in the future.		
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4.9 Interoperability and Security (SIR.8)

Functional Req #	Name	Requirement Statement	IEN Req #	IEN Req Changed
SIR.8.01	Local Agencies retain control authority	Final authority (and responsibility) for control of signal operations will remain under the jurisdiction of the local agencies	2.1.2.5.7.a	
SIR.8.02	User profile administration	Administrators and users will create and maintain profiles of information and capabilities for each user	2.1.2.5.7.b	
SIR.8.03	User name	Administrators will assign a unique name to each user. User name will be unique across county-wide system.	2.1.2.5.7.c	
SIR.8.04	User password	Each user on the system will have an individual password	2.1.2.5.7.d	
SIR.8.05	User access level	Each user will be assigned an access level for each system resource	2.1.2.5.7.e	
SIR.8.06	User access by time of day	User access may vary by time of day	2.1.2.5.7.f	
SIR.8.07	Password protection for users	No user will gain access to the system without entering a valid user name and password	2.1.2.5.7.g	
SIR.8.08	Read access to county data	All users will have read access to equipment status and congestion data in the county server	2.1.2.5.7.i	
SIR.8.9	Read access to subregional data	All users within a corridor will have read access to all equipment status and congestion data in the corridor server	2.1.2.5.7.j	
SIR.8.10	Remote access to controller data	Jurisdictions may grant certain outside users or locations monitoring and control access to some or all of the jurisdiction's intersection controllers	2.1.2.5.7.k	
SIR.8.11	Plan selection access to controller	Authorized users may select the timing plan in use on certain intersection controllers	2.1.2.5.7.l	
SIR.8.12	Plan modification access to controller	Authorized users may modify timing plans stored in a traffic control system	2.1.2.5.7.m	
SIR.8.13	Intersection timing modification access	Authorized users may modify intersection timing on specified intersection controllers	2.1.2.5.7.n	
SIR.8.14	Supervisor access	Authorized users may arbitrate conflicting requests for write access to particular intersection controllers (by terminating access if by no other means)	2.1.2.5.7.p	
SIR.8.15	Administrator	Authorized users may create new users and add	2.1.2.5.7.q	



Functional Req #	Name	Requirement Statement	IEN Req #	IEN Req Changed
	access	new pieces of equipment to the system		
SIR.8.16	Intersection group protection	Jurisdictions may define intersection groups and grant access to a group in a single operation	2.1.2.5.7.r	
SIR.8.17	Multi-user data access	The system will allow multiple simultaneous operators to monitor controller behavior	2.1.2.5.7.s	
SIR.8.18	Multiple read access	Multiple users may monitor the same data item if they have been granted read access to that data item	2.1.2.5.7.t	
SIR.8.19	Single write access	Only one user at a time may modify behavior of an intersection controller	2.1.2.5.7.u	
SIR.8.20	Involuntary ending of write access	Supervisors may end write access to an intersection controller for users which hold this access	2.1.2.5.7.v	
SIR.8.23	User access logging	The system will log all user actions that modify its behavior. The log entry will include user name, action, time, and date of action.	2.1.2.5.7.w	
SIR.8.24	Critical function warnings	The system will warn users when they perform actions that might harm the operation of an entire system.	2.1.2.5.7.x	Y

4.10 Implementation Costs (SIR.9)

No specific implementation cost functional requirements have been identified.

4.11 Operations and Maintenance (SIR.10)

No specific operations and maintenance functional requirements have been identified.

4.12 Existing Infrastructure (SIR.11)

Functional Req #	Name	Requirement Statement	IEN Req #	IEN Req Changed
SIR.11.01	Compatibility with Existing Infrastructure	The integration component shall be compatible with all existing ITS elements, traffic signal controllers, and systems in the Pomona Valley subregion.		

4.13 Reliability (SIR.12)

Functional Req #	Name	Requirement Statement	IEN Req #	IEN Req Changed
SIR.12.01	Local agency data maintenance	Each local agency will be responsible for the collection and maintenance of data within the system to meet the requirements of the integration system.		



5.0 LIST OF ACRONYMS

ACE	Alameda Corridor East Construction Authority
ATIS	Advanced Traveler Information System
ATMS	Advanced Traffic Management System
Caltrans	California Department of Transportation
CAMS/IEN	Los Angeles County Countywide Arterial Management System/ Information Exchange Network
CCTV	Closed Circuit Television
DMS	Dynamic Message Sign
ITS	Intelligent Transportation System
LA	Los Angeles
LACDPW	Los Angeles County Department of Public Works
LACMTA	Los Angeles County Metropolitan Transportation Authority
MOU	Memorandum Of Understanding
NTCIP	National Transportation Communications for ITS Protocol
O&M	Operations and Maintenance
PC	Personal Computer
PTZ	Pan, Tilt and Zoom
PVITS	Pomona Valley Intelligent Transportation System
TMC	Traffic Management Center
TOD	Time-of-Day
UFR	User Functional Requirements
UIR	User Interjurisdictional Requirements
UOR	User Operational Requirements
USR	User Supplementary Requirements
WWV	National Institute of Standards and Technology Time & Frequency shortwave radio station that broadcast accurate real time